DTU Library

Exposure to chemicals in consumer products: The role of the near-field environment

Fantke, Peter; Csiszar, S.A. ; Huang, L.; Jolliet, O.

Published in:
SETAC Europe 26th Annual Meeting

Publication date:
2016

ABSTRACT BOOK

SETAC Europe 26th Annual Meeting
22-26 May 2016, Nantes, France

Environmental contaminants from land to sea: continuities and interface in environmental toxicology and chemistry

Nantes 2016
SETAC Europe

SETAC

to assess the ecological risk of sediment-bound contaminants In this work we study the relationships between the sediment chemistry, the toxicity testing and the status of biological communities, in order to a) assess the degree of (dis)agreement among these three LoEs; b) identify the factors and conditions more likely distorting the expected cause-effect relationships; and c) suggest improvements in the risk-based approach for the management of dredging operations in the coastal areas of Spain. Data from several studies carried out by AZTI in the Basque coast (N. Spain) for different institutions were considered in this work. Overall, almost 300 sediment samples collected along the Basque coast with chemical information of contaminants (heavy metals and organic contaminants) and, at least, one biological LoE (toxicity testing and/or benthic communities) were considered. Most of the metal concentrations in the sediments were well above the ERL, and values above ERM were frequent, suggesting that adverse toxic effects were likely to occur. Statistically significant correlations have been found between variables of the three LoEs: e.g. %organic matter, PCBs, Cr, Ni and Zn are correlated with AMBI, Microtox® and anphipods toxicity. The quality status of the benthic communities was not clearly related to the others LoEs. This indicates the complex relationships between the chemical and the biological compartments.

90

A weight of evidence approach for assessing remediation of contaminated sediments using food web tissue contamination, biotic condition and DNA damage.

J.M. Lazorchak, U.S. EPA / Office of Research and Development; J. Meier, NCOAA Retired; K. Fritz, M. Mills, U.S. EPA; P. Wernsing, U.S. EPA Office of Research and Development; H. Haring, The McConnell Group; D. Walters, USGS / Fort Collins Science Center; J.M. Kraus, U.S. Geological Survey; B.M. Armstrong, Michigan State University / Fisheries and Wildlife

The Ottawa River drains northwestern Ohio, flowing into Lake Erie's western basin at the city of Toledo. The Ottawa River is a component of the Maumee River Area of Concern (AOC) as defined by the International Joint Commission's Great Lakes Water Quality Agreement. A sediment remediation project took place in the lower 14.2 km of the river where urban and industrial activities impacted the river as a beneficial resource. Sediment was removed based on a surface weighted average concentration model where PCB and PAH levels exceeded targeted levels. This presentation will focus on three biological tools used to assess remedy effectiveness: change in fish, invertebrate and Tetragnathid spider tissue concentrations of PCBs and PAHs, DNA damage in Brown Bullhead and macroinvertebrate biotic condition as measured by Ohio EPA Lacustrine Index of Community Integrity (LICI). From 2009-2013 and again in 2015, pre- and post-remedy sampling of fishes representative of different trophic levels was conducted via electroshocking and fyke net sampling. The study area was divided into three river reaches with distinct hydrogeomorphology. Fish collected from each reach included: Largemouth Bass, Brown Bullhead, White Sucker, Pumpkinseed, Gizzard Shad, Bluntnose Minnow and Emerald Shiner. Blood samples were collected from 10 Brown Bullheads from each reach to assess DNA damage using Comet Assay methods. Multi-plate samplers were deployed for collection of macroinvertebrates for tissue analyses and biotic condition assessment. DNA damage in Brown Bullhead increased during dredging then declined in subsequent years. Largemouth Bass, White Sucker, Brown Bullhead, Pumpkinseed, Bluntnose Minnow, macroinvertebrate & spider tissue concentrations showed no change 3-y post dredging compared to pre-dredging. Gizzard Shad and Emerald Shiner showed lower tissue concentrations 3-y post dredging compared to pre-dredging across the entire project area. No difference in the LICI was found based on samples collected before and after dredging. Based on modeling performed during the design phase, it was anticipated that the long-term clean up goals would be met approximately 10 years after the completion of dredging activities, by 2020.

91

A comparative approach using ecotoxicological methods from single-species bioassays to model ecosystems

A. Hägerbäumer, Bielefeld University / Animal Ecology; S. Höss, Ecossa; E. Claus, Federal Institute of Hydrology / Department Biochemistry and Ecotoxicology; P. Heininger, Federal Institute of Hydrology / Division Qualitative Hydrology; W. Traunspurger, University of Bielefeld / Department of Animal Ecology

Effects on natural nematode assemblages to chemical stress (Zn) were assessed in this study in complex sediment microcosms, including indirect food-web effects, and in acute community toxicity tests, considering direct toxicity only. Responses of the various freshwater nematode species in both approaches were compared to effects of Zn on the well-established model organism *C. elegans* in standardized toxicity tests (ISO 10872). The acute tests were performed with a concentration of 20 mg Zn/L, resulting in a sensitivity ranking of *in situ* nematode species. The findings only partly reflected classifications of nematode species according to the NemaSPEAR[%]-index but underlined the function of *C. elegans* representing the sensitivity of freshwater nematodes. The sediment in the microcosms was spiked with nominal Zn concentrations of 10 and 100 mg Zn/kg Sediment (dw). Over the course of the study, Zn had strong dose-dependent effect on nematode abundance, species richness, and species composition, as well as on the NemaSPEAR[%]-index,with significantly lower values in HD-microcosms. Additionally, standardized *C. elegans*-toxicity tests with whole sediment samples and filtered pore water were conducted to estimate bioavailability and direct toxicity, indicating that concentrations causing sublethal effects in *C. elegans* have already severe effects on natural nematode communities. Even at relatively low pore water concentrations of 1 mg Zn/L, corresponding a 20% inhibition of reproduction of *C. elegans* only, striking effects on the natural nematode assemblages could be observed. By this study, a better interpretation of toxicity bioassays in terms of sediment quality assessment was aimed. Whereas the function of *C. elegans* as representative of nematodes could be confirmed when comparing its sensitivity to common freshwater species, results of the more complex microcosm approaches underline the importance of considering also indirect (food-web) effects. Combining sophisticated experimental tools with field observations allows for more accurate decision making in environmental risk assessment. Data on chemical concentrations, single-species and community toxicity, and in-situ assemblages can be integrated as single lines of evidence in a weight-of-evidence approach. As suitable ecotoxicological tools and ecological indices (NemaSPEAR[%]-index) for nematodes are already available, this organismal group should be used more often in sediment quality assessments.

Advances in exposure modelling: bridging the gap between research and application (II)

92

Exposure to Chemicals in Consumer Products: The Role of the Near-Field Environment

P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division; A. Ernstoff, Quantitative Sustainability Assessment; S. Csiszar, 2Oak Ridge Institute of Science and Education at U.S. EPA; L. Huang, University of Michigan / Dept of Environmental Health Sciences; O. Jolliet, University of Michigan

Humans can be exposed to chemicals in consumer products during product use and environmental releases with inhalation, ingestion, and dermal uptake as typical exposure routes. Nevertheless, chemical exposure modeling has traditionally focused on the far-field with near-field indoor models only recently gaining attention. Further, models that are mostly emissions-based, may not necessarily be applicable to all types of chemical release from consumer products. To address this gap, we (1) define a framework to simultaneously account for exposure to chemicals in the near- and far-field, (2) determine chemical product concentrations for various functional use categories, (3) introduce a quantitative metric linking exposure to chemical mass in products, the Product Intake Fraction (PiF), and (4) demonstrate our framework for various consumer product categories. This framework lends itself to high-throughput calculations for characterizing exposure to the vast consumer product chemical space. The chemical mass in products is used as a starting point for quantifying human exposure obtained by multiplying the chemical concentration (e.g. % w/w) in the product with the amount of product used per defined application. Chemical concentrations in products can be obtained from empirical studies, formulations and associations described in databases, or when unavailable, estimated based on chemical-product functions or regulatory frame formulations. Exposure is quantified by estimating the PiF, the fraction of the chemical in a product that is taken in by humans via each exposure pathway, considering specific compartments of entry into the near-field environment (releases of chemicals encapsulated in articles, indoor air spray, etc.). To estimate PiFs, we combined far-field environmental compartments with near-field compartments and exposure pathways in a multimedia matrix of transfer fractions, with columns and rows for each compartment and exposure pathway. The multiple transfers and PiFs (e.g. from chemicals encapsulated in articles to inhalation of indoor air and dermal uptake via skin contact) were obtained by inverting the transfer fractions matrix, yielding cumulative multimedia transfer fractions. PiFs for various chemicals in products were found to be on the order of $1x10^{-7}$ for semi-volatile organic compounds (SVOCs) in thick flooring, $5x10^{-3}$ for VOCs in indoor air spray, and up to 95% or even higher for ingredients in leave-on cosmetic products.

93

Junge relationships in modelled and measured concentrations of chemical pollutants in the Danube River

C. Coll Mora, Stockholm University / Environmental Sciences and Analytical Chemistry; C. Lindim, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. MacLeod, ITM - Stockhom University / Department of Environmental Science and Analytical Chemistry ACES; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES

Persistence is an undesirable property of chemicals that is difficult to measure in the real environment. Junge relationships describe the correlation between the relative standard deviation of concentrations of chemicals and their residence times. Once calibrated for a set of compounds they can potentially be used to estimate the persistence of pollutants. The parameter *b* in the Junge equation is a